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instrument, the case study represents one of the more rewarding forms of research, particularly where application is concerned. Exposure to high-level officials provides an immediate and demanding test of accuracy and effectiveness and, through the feedback that ensues, serves to enrich the quality of the case materials.

Since the program participants are experienced observers of events and well-qualified to quantify their impressions (Flag and General rank military and civilians of comparable status), each who attended the first year's session was asked to evaluate the standard parameters of program assessment and to assess the degree to which something useful had been learned in each of nine major areas of emphasis. The following represents their evaluation of the "standard parameters" -- on a scale of 1 (ineffective) to 5 (extremely effective):

. Overall usefulness	4.31
. Instructors	4.06
. Cases	4.00
. Discussion groups	3.69
. Administration	4.78

The principal objective of the program was to enhance the participants' understanding of differences in interest, perspective, and style associated with varying degrees of responsibilities in differing organizations (and to thereby enhance their ability to devise and implement effective solutions). The overall score on meeting this objective was 4.20. In refining this aspect of the assessment, each participant was asked to evaluate on a scale of 100 to 1000 the degree to which he or she felt competent to deal with issues in each of the five prescribed areas -- prior to the program, immediately following the program, and six months later (after sufficient time had elapsed to permit meaningful application of what had been learned). In this regard, the average participant entered the program with a mean "competence" of 619 across all areas. During the course of the program, this index increased to 714, a fifteen percent improvement.

Although the intent of the program was to provide tools which the participants would find useful on an ongoing basis, it was nevertheless anticipated that the index would fall off somewhat during the six months following completion of the program (as any post-program euphoria dissipated). This proved not to be the case, however, as the index continued upward another four percent to the 741 level. It would appear, then, that the effort to provide "tools" succeeded beyond original expectations.

In comparing the performance of those who had previously received War College training with those who had not, it was noted that the former gained more from the program (both during and after), even though they entered with high levels of felt competence.

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EFFECTIVENESS OF SHORT-TERM TRAINING PROGRAMS
FOR SENIOR NATIONAL SECURITY OFFICIALS

Final Report

for

Organizational Effectiveness
Research Program
Office of Naval Research (Code 452)
Under Contract #N00014-78-C-0837; NR170-878

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Effectiveness of Short Term Training Programs for Senior National Security Officials

To assess the effectiveness of short-term training programs for senior national security officials, research is being conducted on two fronts. First there is the research that is required to develop a program that can serve as a suitable model, i.e. the new Harvard Executive Program in National Security. Second is that which is required to assess how effectively the program meets its basic objectives.

The research to support the program itself primarily involves the development of appropriate case studies. As the program's principal pedagogical instrument, the case study represents one of the more rewarding forms of research, particularly where application is concerned. Exposure to high-level officials provides an immediate and demanding test of accuracy and effectiveness and, through the feedback that ensues, serves to enrich the quality of the case materials. This certainly proved to be the case with the six new cases that were developed for the first session of the Executive Program in National Security. These included two cases on the Panama Canal Treaty negotiations, one on the Philippine Base negotiations, and three on Eurocommunism.

While the basic supporting research is a critical ingredient in the makeup of the program, it is the assessment of program effectiveness that constitutes the principal focus of this report. In determining the best approach for evaluating program effectiveness, a thorough knowledge of the background leading to the program's inception becomes helpful.

BACKGROUND

As the panoply of government problems has grown increasingly complex, the need for improved executive development in the public sector has become more readily apparent. The very manner in which the Federal Service is structured, with its continual turnover of political appointees in most of the top policy jobs (some of whom are qualified; others not) tends to foster inefficiency in policy design and execution.

A recent survey of top level officials within the national security community suggests a strong need to improve management capability in both the military and civilian spheres. On the military side, there is currently very little available in the way of continuing education at the "corporate executive level." While there is a plethora of training programs and opportunities available for military personnel at the O-4 through O-6 levels (Lieutenant Commander through Captain; Major through Colonel), there is very little beyond that. Each of the Services does send its Flag officer selectees to an indoctrination course of two or three weeks duration, but these courses, for the most part, have an internal Service focus and tend to be somewhat mechanical in nature.

Although little in the way of executive training is offered for Flag and General officers, the need for something substantial is quite real. In some respects, the term "General" ought to equate to "generalist manager." In most instances, however, the path to Flag or General officer rank is quite specialized; and once there, the individual can serve for as many as ten to fifteen years with virtually no opportunity for intellectual or managerial refurbishment. Adding to the problem is the fact that there are certain areas of critical importance to the top Service manager which are not covered well in any of the multitudinous forums to

which he or she may have been exposed along the way. Here reference is specifically made to how business is conducted between the Department of Defense (DOD) and the Congress; how the different perspectives of the Office of the Secretary of Defense (OSD), the Joint Chiefs of Staff (JCS), and the Services come into play; what is involved/required in getting decisions implemented; and the like. The situation is further exacerbated by the inevitable tendency for the incumbent (or the incumbent's superior) to feel that the job demands at that level are too consuming to permit extrication for any significant period of training.

The needs on the civilian side are even more pressing. In May of 1974, the U. S. Army Management Engineering Training Agency (AMETA) conducted a "Study of Management and Executive Development in Industry, Universities, and the Federal Government." In this study, the authors struck a comparison between executive development efforts in the private and public sectors and found the latter wanting. They basically concluded that executive development in government is anything but institutionalized; that there is little, if any, accountability by senior managers; and that there is no system for identifying, training, and tracking prospective executives.

More recently in March of 1976, a panel of the National Academy of Public Administration completed a study entitled "Strengthening Civilian Executive Development in the Department of Defense." Conducted at the request of the Assistant Secretary of Defense (Manpower and Reserve Affairs), the study generated a number of recommendations that accommodated

what the panel found at that time to be the general characteristics of Federal Civil Service (i.e., limited lateral entry, little mobility between agencies or occupational groups and virtually no "conscious system" for developing executive leadership) while specifically addressing the unique problems of DOD. In this regard, the panel saw the need for consistent top level support of executive development programs as the most critical problem facing the Department. Sheer size coupled with the fact that most career posts in Defense are occupied either by political appointees or the military (with attendant brief periods of incumbency) makes it very difficult to personify the top level interest that is required.

The National Academy study also pointed out that over the five year period from 1976 through 1981, approximately 50% of the DOD super-grade workforce would become eligible for retirement. Thus, it was suggested that a primary focus of DOD executive training should be to develop the replacements for what is likely to be an inordinately high number of vacancies. Related to this suggestion was the fact that the civilian personnel system, while not a closed system, is heavily dominated by single career personnel. Indeed, approximately 80 percent of DOD GS 16-18 jobs are filled from within the Department. The inference is twofold: (1) it is unrealistic to shortchange executive development on the basis that potential candidates have already received such training in private industry prior to entering government and (2) any executive development program for DOD should be heavily slanted toward meeting the specific requirements associated with managing the national security process.

In view of the above, Harvard University decided in April of 1978 to offer a two week Executive Program in National Security on an annual basis, with the first program to take place in August of the same year. In January 1979, the Navy Personnel Research and Development Center published a Navy Civilian Executive Study that implicitly endorsed the intent behind the Harvard effort (and any others like it):

Although relatively few executives have had extensive academic training in management, leadership, or administration, they spend most of their time performing tasks in these areas. This highlights a major training need. It includes. . . general management knowledge and skills (e.g. decision-making, communications). . . A need was also identified for the integration of civilian and military training in the shore establishment.

COURSE DESCRIPTION

Modeled after earlier programs pioneered by the Business School for senior business executives, the Executive Program in National Security (subsequently renamed the Executive Program in National and International Security) is designed for Flag and General rank military officers and for high-level civilian officials who are either in, or moving into, posts where their personal decisions or recommendations can critically affect the political, economic, or military interests of the United States. Its principal goals are to improve participants' understanding of:

- differences in interest, perspective and style associated
with varying types of responsibilities in differing organizations
- the economic, political, technological, and organizational context within which national security policies and programs are framed
- various dimensions of high-level management, including the uses and misuses of formal analysis in decision-making and policy design

COURSE EVALUATION

Since the participants are experienced observers of events and well-qualified to quantify their impressions, each who attended the first year's session was asked to evaluate what might be considered the standard parameters of program assessment (Attachment A). The following summarizes the more salient of these:

1. On a scale of 1 (ineffective) to 5 (extremely effective):

a. Overall usefulness	4.31
b. Instructors	4.06
c. Cases	4.00
d. Discussion groups	3.69
e. Administration	4.78

2. With respect to:

<u>Program expectations</u>	<u>Work load</u>	<u>Program length</u>
20--equalled	29--about right	29--about right
8--exceeded	1--too heavy	1--too long
1--fell short	1--too light	1--too short
1--parts exceeded; parts fell short		

3. Comparison of pedagogical approach with those experienced in other educational programs: 4.22

While the principal themes of the program include management perspective, policy development, and uses of analysis, it is the former that constitutes the central thread of the curriculum. In getting participants to think critically about the perspectives, stakes, and interests of their counterparts in and around government, it becomes necessary to analyze the setting in which problems arise and the particular incentives which various actors face. Individuals behave differently in different organizational settings according to: (1) their own history and that of their organization, (2) the reward/sanction structure posed by their career system, and (3) which of the many faces of an issue they confront.

The dimensions along which these aspects are treated during the course of the program include: the Congress, political appointees, careerists, the media, business, and labor. In addition, special attention was also paid to budgeteers and analysts, ethics and personnel systems.

The overall score assigned the program with respect to meeting its principal objective of increasing the students understanding of the perspectives of other participants in the national security process was 4.20. In refining this aspect of the assessment, a "ratio scaling" procedure was used wherein each executive was asked to evaluate on a scale of 100 to 1000 the degree to which he or she felt competent to deal with issues in each of the above-cited areas of emphasis (Attachment B). In this regard, a series of three data points were taken: one prior to the program, one immediately following completion of the program, and one six months later (after sufficient time had elapsed to permit meaningful application of what was learned.) In view of the heavily subjective nature of the total evaluation scheme, however, the pre-program data was taken at the same time as that immediately following the program. This was done to help ensure greater consistency in standards, i.e., the participants may not have fully appreciated at the outset how weak (or strong) they were in a given area as they were after they had completed the program. It also had the added benefit of avoiding an artificial "ceiling effect" wherein one might have given oneself the highest rating possible at the beginning of the program and, after learning considerably more during the program, then been forced to use the same (but subsequently misleading) rating.

As indicated in Table I, the average participant entered the program with a mean "competence" of 619 across all areas, i.e., the "average participant" felt about 62 percent as competent or comfortable in an "average area" as he or she did in an area with which they were thoroughly familiar and in which they felt well qualified (see Attachments C and D). During the course of the program, this mean index increased to 714, a fifteen percent improvement over the pre-program level.

TABLE I
Average "Competence" Across All Areas

	<u>Pre-Program</u>	<u>Post-Program</u>	<u>Six Months Post</u>
Total Group (N=29)	619	714	741

Although the intent of the program was to provide tools which the participants would find useful on an ongoing basis, it was nevertheless anticipated that the index would fall off somewhat during the six months following completion of the program (as any post-program euphoria dissipated). This proved not to be the case, however, as the index continued upward another four percent to the 741 level. It would appear, then, that the effort to provide "tools" succeeded beyond original expectations.

Although the foregoing provides some feel for short-term program effectiveness, even more revealing are the increases in the indices for each of the specific areas of emphasis:

Area	<u>TABLE II</u> <u>Pre-program</u> <u>Level</u>	<u>Gain During</u> <u>Program</u>	<u>Gain in Six Months</u> <u>Following Program</u>
Ethics	762	57	16
Personnel Systems	703	61	12
Military vs. Career Civilians	699	46	22
Budgeteers/Analysts	616	100	36
Congress	615	105	38
Politicians	612	111	30
Business and Businessmen	601	96	32
Media	589	88	28
Labor Relations	376	193	24

In general, the program raised the perceived level of competence in all areas but had little effect on the overall rank order (Budgeteers/Analysts, Congress, and Politicians reversed positions, going from 616, 615, and 612 to 716, 720, and 723 respectively). For Labor Relations, the area with the lowest initial level of felt competence, a rather dramatic increase from 376 to 569 was realized. However, at the end of the program the respondents still had less confidence in their ability to operate in this area than in any other. With one exception, the respondents learned most in those areas where they initially knew the least. The exception, as indicated in Table II, was in the "media" category where a number of respondents indicated lower competence both immediately following the program and six months later. The reason behind this has to do with the nature of the program presentation made in this area. In exploring the nuances of the First Amendment, it illustrated (and quite effectively) the non-monolithic character of the press. Hence, participants left the experience feeling, at least in some instances, that they didn't know as much about the media as they originally thought they did upon first entering the program.

In comparing the reactions of those participants who had attended War College with those who had not, it was noted that the former entered the program feeling more competent (647 vs. 594) and left feeling that they had gained more (103 vs. 91 during the program, and 31 vs. 25 after). Thus it appears that the War College graduates generally gained more from the program than did their non-War College peers (see Attachment E).

As part of the six month follow-on assessment, participants were asked to what extent their improved understanding of the perspectives of others had helped them in the performance of their jobs, particularly as manifested in: (1) the development of goals and the strategy to support achievement of those goals, and (2) the framing and presentation of programs in mixed arenas. They rated these two categories at 3.96 and 3.80 respectively.

THE LONGER VIEW

Since the six months data shows a continuing increase in levels of competence/comfort, the question arises as to what one might expect to see with respect to long term program impact, e.g., a year following program completion. The analysis below examines as one possibility the existence of a Markov relationship between successive six month data points and contrasts the results with those that would obtain from simple asymptotic extrapolation.

To explore the possibility of an underlying stochastic process, transition matrices were constructed for the pre-program (Event 1) vs. immediate post program (Event 2) case and for the immediate post program vs. six month post program (Event 3) case within each "area of competence." The first step in doing so required determination of the median level of competence for the 29 sets of pre-program data associated with each "area" (three participants did not provide complete sets of data). The next step was to determine the $\pm .25$ quantile points (upper and lower "hinges") which could serve as the boundaries for three discrete "zones of competence" (See Attachment F). The Event 1-2 matrix for each area

was then compared with the Event 2-3 to determine whether any differences that existed were statistically significant. Table III shows the calculations for the "Business" area.

TABLE III

"Business" Event 1-2 and Event 2-3
Transition Matrices

	<u>EVENT 1-2</u>	<u>EVENT 2-3</u>						
H (> 800)	<table border="1"><tr><td>8</td><td>0</td><td>0</td></tr></table>	8	0	0	<table border="1"><tr><td>13</td><td>0</td><td>0</td></tr></table>	13	0	0
8	0	0						
13	0	0						
M (575 - 800)	<table border="1"><tr><td>5</td><td>9</td><td>0</td></tr></table>	5	9	0	<table border="1"><tr><td>2</td><td>11</td><td>0</td></tr></table>	2	11	0
5	9	0						
2	11	0						
L (< 575)	<table border="1"><tr><td>0</td><td>4</td><td>2</td></tr></table>	0	4	2	<table border="1"><tr><td>0</td><td>1</td><td>2</td></tr></table>	0	1	2
0	4	2						
0	1	2						

Applying a Chi Square test for goodness of fit:

$$\chi^2_{4DF} : \sum \frac{(O-E)^2}{E} = \frac{25}{8} + \frac{9}{5} + \frac{4}{9} + \frac{9}{4} + \frac{1}{3} = 7.94$$

(where Event 1-2 is the "EXPECTED" result and Event 2-3 is the "OBSERVED")

It is apparent from the Chi Square test that if the Event 1-2/Event 2-3 relationship were stationary, one would expect to see differences of the magnitude of those shown above less than 10 percent of the time. Since the findings are similar in each of the other eight areas (see Attachment G), it is apparent that the differences are statistically significant. This suggests one of two possibilities: either the relationship is not Markov, or it is time dependent and has not yet reached its stationary state (if one does indeed exist).

To explore the possibility of a non-stationary Markov, it will be necessary to collect yet another set of data at Time 4, i.e. one year following completion of the program. In anticipating what that data collection might yield, one approach that suggests itself is to assume continued operation of the Event 2-3 dynamics and to apply the Event 2-3 transition matrix to the State 3 distribution to yield a new "state distribution" for Time 4. Making these calculations for the "Business" category:

$$\begin{array}{ccc} \text{H} & \text{M} & \text{L} \\ \left[\begin{array}{ccc} 15 & 12 & 2 \end{array} \right] & \times & \left[\begin{array}{ccc} 1 & 0 & 0 \\ .15 & .85 & 0 \\ 0 & .33 & .67 \end{array} \right] = \left[\begin{array}{c} 17 \\ 11 \\ 1 \end{array} \right] \begin{array}{l} \text{H} \\ \text{M} \\ \text{L} \end{array}$$

$$T_3 \text{ Distribution} \times \text{Event 2-3 Transition Matrix} = \text{Expected } T_4$$

Thus, if the assumption holds true that the same Event 2-3 dynamics are at work during Event 3-4, one might expect to find 17 participants having evolved to the high state, 11 to the medium, and 1 to the low.

To compare possible trends in the absence of T_4 data, simple asymptotic extrapolation was performed using the following equation:

$$\hat{X}_4 = X_3 \left[1 + .284 \left(\frac{X_3 - X_2}{X_2} \right) \right]$$

where the constant .284 is obtained by dividing the increase in mean level of competence over the six months following the program (741-714) by the increase that took place during the program (714-619). Application of this technique to each of the 29 participants' Time 3 scores in the Business area yields a Time 4 distribution of 19 in the high state, 8 in

the medium, and 2 in the low. Table IV compares the results of applying the T_{2-3} approach simple asymptotic extrapolation to the data associated with each of the nine areas of emphasis.

TABLE IV

AREA	APPLY EVENT 2-3 MATRIX			ASYMPTOTIC EXTRAPOLATION		
	<u>H</u>	<u>M</u>	<u>L</u>	<u>H</u>	<u>M</u>	<u>L</u>
1. Congress	21	8	0	21	7	1
2. Politicians	19	10	0	17	10	2
3. Media	13	15	1	14	13	2
4. Budget	22	6	1	22	5	2
5. Business	17	11	1	19	8	2
6. Mil/Civ	16	10	3	14	12	3
7. Personnel	9	18	2	13	12	4
8. Labor	17	12	0	16	13	0
9. Ethics	9	20	0	11	18	0

As shown in the table, continued application of the Event 2-3 matrix yields results which are generally quite close to those determined through extrapolation.

As stated earlier, a data collection at Time 4 will be required to determine which, if either, of the above projections reflects the actual distribution that will obtain at that time. However, if one accepts the premise that the program has, in fact, provided "tools" that will be of continuing use, the possibility of a Markov relationship between successive six month data points (probably displaying Event 2-3 dynamics) cannot be discounted.

PREDICTION OF APPLICANTS

Yet another, albeit less direct, measure of effectiveness is the degree to which successive runs of the program attract increasing numbers of applicants. Since there is only a single year's worth of data currently available, it is not possible at this point to predict with any certainty the likely number of applicants for succeeding years. It is possible, however, to explore the construction of a hypothetical model which can be refined with successive runs of the program.

The first step in developing such a model would be to define the relationship between the number of applicants from each agency and any variables that seem important. In this case, the variables might include the number of eligible candidates within the agency (both military and civilian), the agency's training budget (dollars available per eligible candidate), the number of program brochures sent to the agency, and the number of personal marketing visits paid to individuals within that agency. To determine the relationship, a multiple regression model has been used. In this type of model, an attempt is made to derive the equation of the following form that best fits the observed data:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i}$$

where

y_i = no. of applicants from agency

x_{1i} = training budget for agency

x_{2i} = no. of eligible candidates from agency

x_{3i} = no. of brochures mailed to agency

x_{4i} = no. of visits to agency

β = regression coefficients

In other words, the attempt is made to find the linear combination of independent variables that best fits the observed dependent variable. The

"best fit" is determined by choosing the β coefficients so as to minimize the resultant squared error of the estimates. If $\hat{\beta}$ is the estimated vector of coefficients, and $y_i = \beta^T x_i$ then $\hat{\beta}$ is chosen so that $\sum_i (y_i - \hat{y}_i)^2$ is a minimum over all possible choices of $\hat{\beta}$.

In this case, a packaged stepwise multiple linear regression program* was used, and analysis was performed using the data in Table V. It should be noted that this is a biased sample: it does not include data from agencies which sent no attendees. Therefore, the derived equation does not provide estimates of how many applicants will come from a given agency with a given budget, etc., but rather, estimates of the number of applicants, assuming that there was at least one applicant in FY 1978.

TABLE V
Regression Data 1978

Agency	#Applicants	#Eligible Civ	Mil	Training Budget (\$ per person	Bro- chures	Visits
Army	1	297	432	652	25	4
Navy	2	372	261	790	41	7
Air Force	6	193	269	1045	23	3
Marine Corps	1	5	66	390	5	2
Naval Reserve	1	0	40	307	3	2
Army Reserve	1	0	92	420	3	2
OSD/JCS	4	346	0	112	64	5
Coast Guard	1	0	31	303	8	1
State	1	1047	0	435	39	7
AID	1	344	0	334	10	1
Treasury	1	314	0	274	4	1
OMB	1	80	0	63	5	1

*Series 60 (level 66)/6000 Time Sharing Application Library Guide, Vol. II Statistics; Stepwise Linear Regression Program. Honeywell Information Systems, Inc.; copyright 1976.

In proceeding on a stepwise basis, it was determined that training budget was the most significant variable for a one variable equation. For a two variable, "brochures" was the next most significant; for a three, the number of personal visits. No equation with four variables provided any significant additional "explanation" of the variance in the number of applicants. The results of the analysis were as follows:

$$\# \text{applicants} = .42 + .004 (\text{budget}) + .105 (\# \text{brochures}) - .790 (\# \text{visits})$$

This equation was found to explain almost 75% of the variance in the dependent variable. Conspicuously absent is the variable relating to number of eligible participants, since it did not provide sufficient information to merit its inclusion. Also of note is the negative coefficient relating to numbers of personal visits. As with any regression, care should be taken not to draw causal inference. In this case, it should not be concluded that the visits adversely affected the number of applicants. It was, instead, a matter of concentrating attention on those agencies which were most resistant to sending anyone in the first instance.

It was originally hoped that the number of 1979 applicants could be estimated using this regression equation since the estimated FY79 training budgets are known for each agency, as are the projected numbers of visits and brochures. However, the visitation and brochure policies have changed significantly between 1978 and 1979. In FY78 only one agency received more than fifty brochures and all but four received at least two visits. In FY79 four agencies received well over 100 brochures and only two received more than 1 visit. This change in the tone of the recruiting effort would

render any estimate of applicants highly unreliable. When the FY79 applicants are known, the enlarged sample should permit the formulation of a more comprehensive regression model. The most complete statement that can be made at this time is that, in FY78, the relationship among the dependent and independent variables was as given above.

The second component of the model looks at the application process as a random Poisson process within each agency. The Poisson process is characterized by an event with a small probability of occurrence, but a large number of possible occurrences. In this situation, the probability that a specific individual from any given agency will attend the program is small,, yet there are many such individuals who are eligible to attend. Although there is insufficient information in a single sample to determine whether this process does, indeed, fit the Poisson model (this can only be tested after several samples have been taken), it is not unreasonable to assume a fit at this point in time.

Assuming a Poisson process, then, the expected number of applicants from agency i is λ_i . The probability of having x applicants from an agency that has mean λ_i is given by:

$$P (\# \text{applicants} = x) = e^{-\lambda_i} \frac{\lambda_i^x}{x!} \quad *$$

This second part of the model connects with the first through substitution of λ_i as the dependent variable, y_i , and regressing λ_i on the recruiting variables. In this formulation, it is the mean number of applicants λ_i that is expressed as a function of the recruiting variables, while the actual number of applicants in a given year is a Poisson random variate with mean λ_i . The probability of the actual number equalling x may then be determined from the above equation.

*Note that λ is usually expressed as a rate in a λt combination. In this situation, λ has already been normalized and t falls out.

The third part of the model links the Poisson models for the individual agencies into a complete model for the whole program. If the λ_i were equal for all agencies, the predicted total number of applicants would merely be the sum of the predicted number from each agency. However, if the λ_i are not equal, then the situation would be heterogeneous and the predicted number from each agency would have to be weighted by the variance of the individual estimates. The total number of applications then is a function of the individual λ_i and some process which samples from the various Poisson processes. A prime candidate for this sampling process is the Gamma distribution. In other words, the total number of applicants would be a random variable that is the sum of individual Poisson processes sampled according to a Gamma distribution. If this is the case, then the total number can be shown to follow a negative binomial distribution. Putting the whole model together:

1. $\hat{\lambda}_i = \hat{\beta}^T x_i$ (λ_i is linear in the recruiting variables)
2. $\text{Prob} (\# \text{ atten}_i = k) = \frac{\lambda_i^k e^{-\lambda_i}}{k!}$ (each agency i has k applicants according to a Poisson process with mean λ_i)
3. λ_i itself comes from a Gamma distribution: $f(\lambda) = \begin{cases} \frac{1}{\Gamma(v)} a^v \lambda^{v-1} e^{-a\lambda} & \text{if } \lambda > 0 \\ 0 & \text{if } \lambda = 0 \end{cases}$

resulting in a Negative Binomial

$$\text{Prob} (k = n) = q^v p^n (-1)^n \binom{-v}{n}$$

$$\text{where } p = \frac{1}{1+a} \text{ and } q = 1 - p.$$

$$\text{The mean } \mu = v p/q \text{ and variance} = \mu(1 + \frac{\mu}{v})$$

The next step is to test this negative binomial model by applying it to the national security program data.

$$1. \text{ Computed } \mu = \frac{21 \text{ applicants}^*}{17 \text{ agencies}^{**}} = 1.24$$

$$2. \text{ Computed variance} = \sum_{i=1}^n \frac{(\# \text{applicants in agency } i - 1.24)^2}{n-1} = 2.3$$

where $n = 17$

3. Using the identities for the mean and variance of the negative binomial, parameters "a" and "v" for this distribution can be computed using the sample mean and sample variance values of 1.24 and 2.3 respectively.

$$\bullet \quad v \frac{p}{q} = \mu = 1.24$$

$$\bullet \quad \text{Since } p = \frac{1}{1+a} \text{ and } q = 1-p, \quad \frac{p}{q} = \frac{\frac{1}{1+a}}{1 - \frac{1}{1+a}} = \frac{1}{a}$$

$$\bullet \quad \therefore v = 1.24a$$

$$\bullet \quad \text{variance } (\sigma^2) = 2.3 = \mu \left(1 + \frac{\mu}{v}\right) = 1.24 \left(1 + \frac{1.24}{v}\right)$$

$$\bullet \quad \therefore v = \underline{1.45} \quad ; \quad a = \underline{1.17} \quad ; \quad p = \frac{1}{1+a} = \underline{.46} \quad ; \quad q = 1-p = \underline{.54}$$

4. Substituting the above values into the model:

$$\begin{aligned} \text{Prob}(k=n) &= q^v p^n \frac{(-1)^n}{n!} \binom{-v}{n} \\ &= (.54)^{1.45} (.46)^n \frac{\Gamma(1.45+n)}{n! \Gamma 1.45} = \frac{-.41}{-.89} (.46)^n \frac{\Gamma(1.45+n)}{n!} \\ &= (.46)(.46)^n \frac{\Gamma(1.45+n)}{n!} \end{aligned}$$

* Eight of the twenty-nine applicants came from organizations which do not lend themselves to analysis, e.g., intelligence agencies whose training budgets, etc. are classified.

** The "17 agencies" figure includes five agencies which yielded no applicants.

5. The probabilities for different numbers of applicants can now be determined:

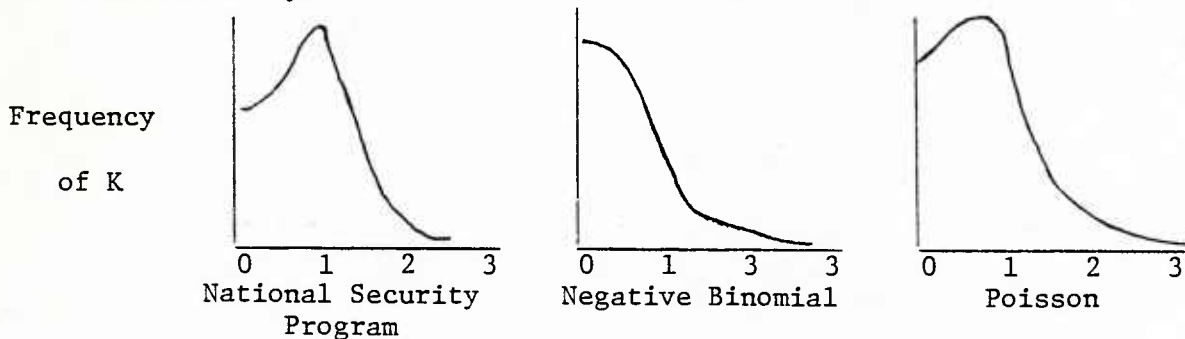
<u>K</u>	<u>Prob n = K</u>
0	.41
1	.27
2	.15
3 or more	.17

6. Performing a Chi Square test, we find the following:

	<u># candidates</u>			
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3 or more</u>
Expected # agencies (as generated by negative binomial)	7	5	3	3
Actual # agencies	5	9	1	2
$\chi^2 = \frac{4}{7} + \frac{16}{5} + \frac{4}{3} = .57 + 3.2 + 1.33 + .33$				

$\chi^2_{3DF} = 5.4 \Rightarrow$ one would expect to see differences on the above order approximately 15% of the time

While the possibility that the number of agencies sending k applicants is distributed as a Negative Binomial cannot be rejected, it may be useful to test a Poisson distribution. A glance at the respective distribution curves reveals why.



Applying a Poisson model yields the following:

$$\text{Prob}(K=n) = e^{-\lambda} \frac{\lambda^n}{n!}$$

$$\text{For } \lambda = 1.24, \text{ Prob}(K=n) = .289 \frac{\lambda^n}{n!}$$

Table VI compares the results obtained from both models with actual program experience.

TABLE VI
Probability that $n = k$

<u>K</u>	<u>Negative Binomial</u>	<u>Poisson</u>	<u>Observed</u>
0	.41	.289	.294
1	.27	.359	.529
2	.15	.222	.059
3 or more	.17	.12	.118

A Chi Square test of the fit of the data to Poisson distribution with mean 1.24 is approximately 3.44 with three degrees of freedom, so the hypothesis that the number of agencies sending k applicants is distributed as a Poisson (where $k = 0, 1, 2, \dots, \infty$) cannot be rejected.

Although additional samplings will be required to determine with precision what the correct distribution actually is, from the calculations above, it seems most likely that the distribution will prove to be Poisson. If so, the assumption of heterogeneity will have been disproved. While there are obviously a number of unquantifiable factors at play within each agency that influence the number of participants the agency ultimately sponsors (such as internal politics and the like), it may hold true that these factors are similar enough across agencies so as to largely offset one another.

As stated earlier, data limitations have dictated that the re-search relating to assessment of long-term effectiveness assume the form of a prospectus. It is only with the additional data that will come from successive runs of the program that the validity of the models can be confirmed -- or the need to refine or revise them verified.

HARVARD UNIVERSITY

EXECUTIVE PROGRAM IN NATIONAL SECURITY

August 13 - 25, 1978

Program Evaluation Questionnaire

Please complete and return to Doug Johnston no later than Friday morning, Aug. 25.

Your candid responses regarding the following aspects of the Executive Program in National Security will assist us in assessing the effectiveness of the program and improving its quality and value for the future.

Note: In those questions calling for a quantified evaluation, please use the following 5-point scale:

- 1 = Ineffective (or Unsatisfactory)
- 2 = Below average effectiveness (or only Marginally Satisfactory)
- 3 = Average effectiveness (or Satisfactory)
- 4 = Above average effectiveness (or Very Good)
- 5 = Extremely effective (or Excellent)

A. Overall Evaluation of the Program

1. Please evaluate the Program in terms of overall usefulness to you.

Ineffective 1 2 3 4 5 Extremely Effective

2. Evaluate the usefulness of Discussion Groups.

Ineffective 1 2 3 4 5 Extremely Effective

3. How did the Program compare with your expectations from the announcement you received?

_____ Exceeded Expectations

_____ Equaled Expectations

_____ Fell Short of Expectations

Comments:

4. How would you assess the work load?

_____ Too Heavy

_____ About Right

5. How would you describe the length of the program?

_____ Too Long

_____ About Right

_____ Too Short

6. If you do not think the program was the right length, what length would you suggest?

_____ 1 week

_____ 3 weeks

_____ Longer

7. Would you attend if it were 3 weeks? yes___ no___ (Why?)

8. Is there a more preferable period than August?

Comment:

B. Evaluation of Classes

1. Please indicate your evaluation of the cases and lecture-discussions for class. Please comment if you think any individual classes were particularly effective or ineffective.

INDOCHINA '54

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

CUBAN MISSILE CRISIS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

TAXING INDUSTRIAL DEVELOPMENT BONDS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

INTERNATIONAL ECONOMICS I & II

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

DEFENSE BUDGET

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

PRINCIPLES OF NEGOTIATION: DISTRIBUTIVE BARGAINING

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

EMPLOYMENT SERVICE REORGANIZATION

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

ASPIN AND DEFENSE BUDGET CUTS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

BAY OF PIGS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

THE MEDIA AND NATIONAL SECURITY

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

INTEGRATIVE BARGAINING (AMPO-ADMINISTRATION NEGOTIATION)

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

PANAMA CANAL TREATY

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

PHILIPPINE BASE NEGOTIATIONS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

KOREA 1980

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

ENERGY AND NATIONAL SECURITY I, II, III

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

SATURDAY NIGHT MASSACRE

Ineffective	1	2	3	5	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

FORCE POSTURE I, II

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

NUCLEAR ENERGY AND PROLIFERATION

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

STRATEGIC FORCES IN 1960s

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

SALT I

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

AMERICAN INDUSTRIES CORP (A, B, C)

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

U.S.-USSR GRAIN AGREEMENT

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

MARX-ENGELS TEXTS

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

SALT II

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

EUROCOMMUNISM I & II

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

EUROCOMMUNISM EXERCISE

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

2. How would you compare the effectiveness of the teaching methods employed in this program with others you may have experienced in other educational programs?

Ineffective	1	2	3	4	5	Extremely Effective
-------------	---	---	---	---	---	---------------------

(Please comment)

3. In comparison with the quality of teaching skills personally observed in other seminars and courses, please indicate your evaluation of the in-class performance of each faculty member in this program.

GRAHAM ALLISON

Ineffective 1 2 3 5 5 Extremely Effective

ALBERT CARNESALE

Ineffective 1 2 3 4 5 Extremely Effective

JOHN DUNLOP

Ineffective 1 2 3 4 5 Extremely Effective

STEPHEN HITCHNER

Ineffective 1 2 3 4 5 Extremely Effective

WILLIAM KAUFMANN

Ineffective 1 2 3 4 5 Extremely Effective

ERNEST MAY

Ineffective 1 2 3 4 5 Extremely Effective

ARTHUR MILLER

Ineffective 1 2 3 4 5 Extremely Effective

JONATHAN MOORE

Ineffective 1 2 3 4 5 Extremely Effective

HOWARD RAIFFA

Ineffective 1 2 3 4 5 Extremely Effective

HUGO UYTENDHOEVEN

Ineffective 1 2 3 4 5 Extremely Effective

DANIEL YERGIN

Ineffective 1 2 3 4 5 Extremely Effective

C. Program Content

1. In what areas would you have liked to have seen greater emphasis placed?
2. Was anything omitted that should have been included?
3. What suggestions would you make for improving the design of the Program?

D. Participation

1. Was the mix of the participants appropriate in terms of:

	No	Yes
Organizational Level	_____	_____
Experience	_____	_____
Ability to Contribute in Class	_____	_____
Ability to Contribute to Discussion Groups	_____	_____

Comments:

2. Did you feel you had sufficient opportunity to contribute in class-room discussions?

3. How did you first learn about the Executive Program in National Security?

Direct correspondence from Program Director _____

Another person in your organization - (colleague, personnel department, other - please specify) _____

Program brochure _____

JFK or HBS Faculty member _____

Other (please specify) _____

E. Administration

1. Please evaluate the level of administrative organization.

Poor 1 2 3 4 5 Excellent

2. Please evaluate the flexibility and responsiveness of the administration.

Poor 1 2 3 4 5 Excellent

3. How would you evaluate the living accommodations?

Poor 1 2 3 4 5 Excellent

4. How would you evaluate the lounge facilities?

Poor 1 2 3 4 5 Excellent

5. How would you evaluate other HBS facilities which you used?

Poor 1 2 3 4 5 Excellent

6. How would you evaluate the meals?

Poor 1 2 3 4 5 Excellent

7. Comments and suggestions:

F. Additional

1. What difference, if any, has the program made in your perception of your own role in the national security process?

2. How effective has the program been in increasing your understanding of the perspectives of other participants in the national security process?

Ineffective 1 2 3 4 5 Extremely Effective

3. (Answer only at the six months point)
If the program has improved your understanding of the perspectives of others, to what extent has this understanding subsequently proven helpful in performing your job, particularly with respect to:

- (a) development of goals and the strategy to support achievement of those goals:

Ineffective 1 2 3 4 5 Extremely Effective

- (b) framing and presenting programs in mixed arenas

Ineffective 1 2 3 4 5 Extremely effective

Signature

Do you think participation from the private sector would enhance or detract from the program?

Would participants from foreign countries inhibit the flow of discussion? On balance do you think their presence would enhance or detract from the program?

Ratio scale ratings relating to
the perspectives and roles of other
participants in the national security process

Please evaluate how comfortable you feel in dealing with/operating in each of the listed areas. If you feel completely comfortable about operating in an area with which you are very familiar, a rating of 1,000 would be appropriate. If you only feel "half comfortable," then the rating becomes 500. If you feel one-tenth as comfortable (as compared to a very well-known area), then the rating should be 100. Ratings of zero (0) and negative ratings should not be used.

The questions listed within each area are intended to be representative of the types of things you should consider in deciding how comfortable you are. They should not be interpreted as representing an exhaustive treatment of any given area.

RATIO SCALE RATINGS

<u>BEFORE</u>	<u>AFTER</u>	<u>6 MOS</u>
<u>PROGRAM</u>	<u>PROGRAM</u>	<u>LATER</u>
_____	_____	_____

I. Congress

- What are the nuances of the legislative process that might make a difference in the way one frames one's programs prior to submission for Congressional approval?
- What are the priorities that are likely to be accorded competing demands for resources by the various national security-related Congressional committees?
- On what issues is Congressional decision-making likely to be driven by the national interest, as opposed to local political considerations?
- How should one deal with the situation where it looks likely that the substance of the issue may be subsumed in jurisdictional infighting, i.e., protection of turf vis-a-vis the Executive Branch, between committees, etc.?
- To what extent should one provide one's personal opinion vis-a-vis unquestioning support for the Administration position?

II. Media

- How does one reconcile the inherent conflict between the media's interpretation of obligations and rights under the First Amendment and the need for secrecy that often underlies "national security considerations"?
- What motivates the press in its pursuit of news?
- How can one use the media to help achieve one's own objective?
- How does one avoid press chicanery, such as the slanting of stories to achieve sensationalism and quoting out of context?
- What is the language with which one should be familiar when dealing with the media ("off the record," "deep background," "non-attribution," etc.)?
- Is citing a "personal opinion" ever appropriate for a top level official when dealing with the media?

III. Politicians

- How should one deal with the fact that the terms and conditions of employment of politicians are considerably different from those for other categories of participants in the national security process?
- What motivates them?
- How does their different risk orientation affect their behavior and perceptions of things?
- How does the politician's role compare with the role of the "Chief Executive Officer" in a business organization?
- What is the best way to cope with the managerial shortcomings of the various categories of political appointees? i.e., educators often are not skilled in the management of large organizations; lawyers are often not skilled in either quantitative analysis or the administration of large organizations; and businessmen often have trouble operating in a "no bottom line" environment.
- In what sorts of circumstances are political considerations likely to prevail over those of substance?

IV. Budgeteers/analysts

- How does one stay ahead of analytical chicanery?
- How can one be sure one is asking the right questions and forcing the right options?
- To what extent is it desirable or necessary to instill an appreciation for, and at least limited accommodation of, organizational process and bureaucratic politics amongst budgeteers and analysts?

V. Business and businessmen

- How should one deal with businessmen so as to elicit the most forthcoming response?
- What is the "business perspective," and the incentives that drive it?
- What are the ramifications of the fact that most national security program managers spend more of their time "selling" their programs than they do managing them?

VI. Military vs. career civilians

- What are the differences in planning priorities between military and civilian planners?
- How do trade-offs between hardware and doctrine influence weapons acquisitions?
- What are the effects of frequent turnover of military personnel on program decision-making and accountability?
- To what extent does a "civil service mentality" affect creativity and initiative in program formulation and implementation?

VII. Personnel systems

- What are the incentives for inspiring top performance in both the military and civilian spheres?
- How do you make the personnel system work for you instead of against you when it comes to hiring and firing and effecting changes in organizational structure?
- How does one avoid the debilitating effects of civil servants working for military bosses who often are unconcerned with civilian career advancement, etc.?

VIII. Labor relations

- How does one deal effectively with unions in the public sector?
- What are the points of leverage available to the public sector manager?

IX. Ethics

- How does one reconcile the inevitable conflict between principle and expediency, particularly when being "too truthful" may result in one pricing oneself out of the market with respect to procurement of a particular weapon system (which in the eyes of the sponsor is critical to the national interest)?
- What are one's moral obligations when relating with the Congress? the press?

Signature

Attachment C

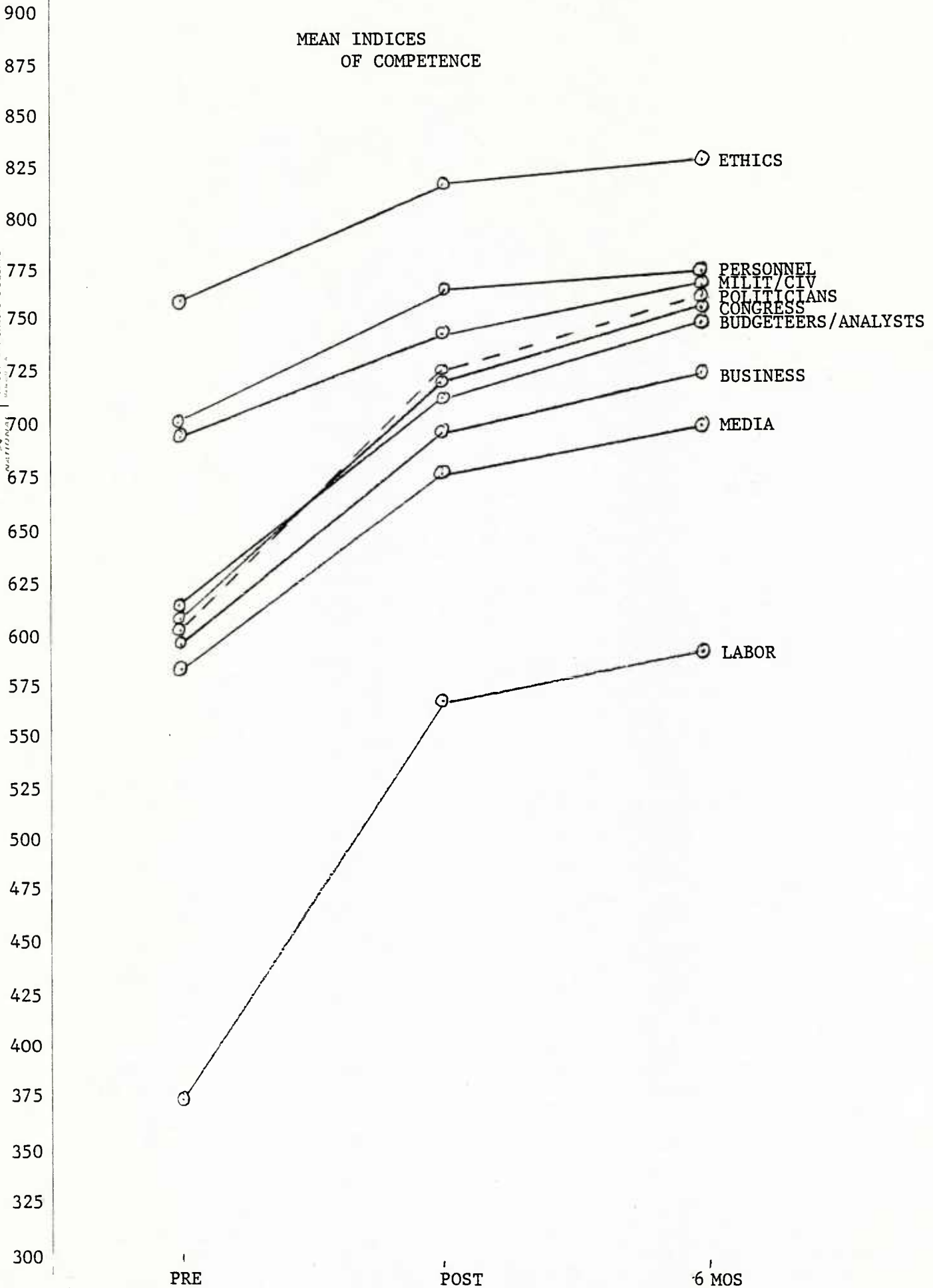
Perspectives and Roles

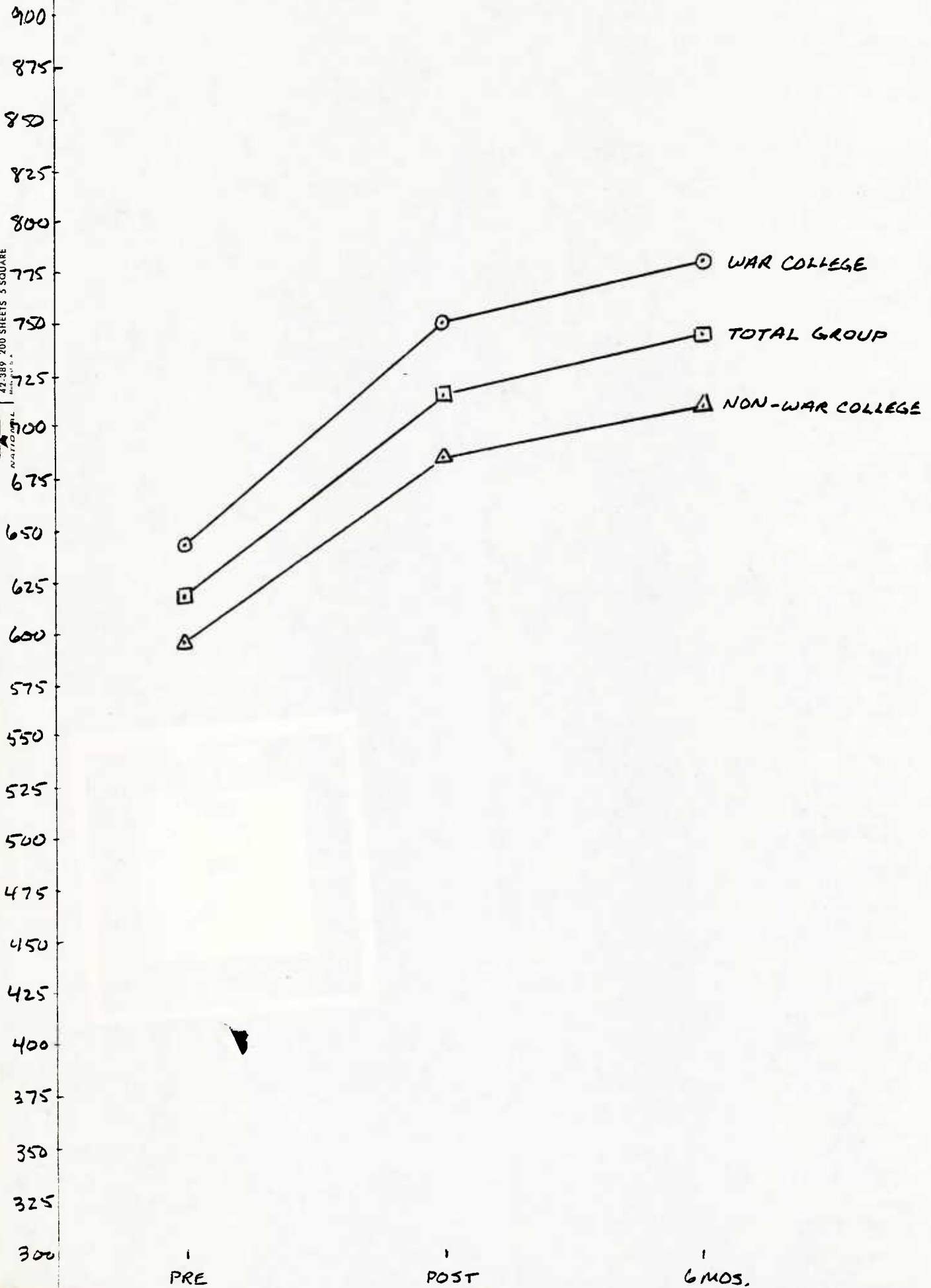
Participants	Congress	Media	Politicians	Budgets & Economics	Business	Military vs. Civilian	Refugees	Labour	Ethics
1	820 960 980	950 980 470	850 930 950	670 770 750	830 930 970	425 950 925	900 930 470	400 500 550	850 950 750
2	810 890 890	725 740 810	725 810 830	690 830 900	700 825 850	700 780 780	615 780 790	100 500 520	750 840 840
3	200 300 525	200 350 400	400 475 475	200 300 950	200 200 200	700 750 760	700 725 750	100 250 250	800 800 800
4	500 750 750	800 800 800	700 800 1000	800 900 500	600 600 700	700 800 800	400 600 600	100 400 300	1000 1000 1000
5	700 750 650	600 650 650	750 790 700	1000 1000 1000	900 900 900	500 500 500	600 700 800	600 700 700	600 650 650
6	100 400 500	200 300 350	400 500 600	500 600 700	500 600 700	800 850 875	500 600 700	400 600 650	600 650 700
7	750 750 800	800 800 800	1000 1000 900	650 675 725	600 700 750	850 850 950	750 750 800	700 700 700	850 850 900
8	480 680 700	600 670 650	700 820 830	500 730 700	930 470 470	575 725 775	530 730 600	350 700 700	600 800 900
9	390 460 500	370 600 620	450 530 600	370 500 530	430 630 600	550 625 725	670 730 730	530 700 700	650 750 750
10	400 600 700	600 700 900	600 700 700	300 400 600	600 700 800	800 800 900	800 800 800	500 600 700	800 800 850
11	1000 1000 1000	800 900 900	1000 1000 1000	700 900 900	600 800 800	900 900 900	800 900 900	500 700 750	900 1000 1000
12									
13	700 900 925	800 950 950	600 850 925	800 900 950	900 950 950	900 950 975	800 850 900	700 800 925	900 950 950
14	800 900 900	1000 300 500	500 800 800	1000 1000 1000	500 800 1000	1000 1000 1000	1000 1000 1000	100 500 500	1000 1000 1000
15	900 900 900	900 700 600	200 400 500	500 700 800	500 500 600	200 800 900	900 900 900	100 400 300	900 900 900
16	700 850 875	650 800 900	650 800 800	600 700 800	750 900 950	700 800 850	750 850 875	700 800 800	800 850 900
17	900 900 900	700 800 750	800 850 875	300 400 450	200 300 400	200 300 300	200 250 275	250 300 300	600 675 700
18	700 500 580	500 530 630	420 540 600	580 720 720	430 600 680	700 730 750	800 820 800	300 400 400	600 650 800
19	600 700 700	850 800 800	600 700 800	500 600 800	400 600 600	800 800 900	700 800 800	300 600 600	800 800 900
20	600 700 750	100 500 500	400 600 500	800 900 900	900 900 900	500 600 750	800 900 850	100 500 500	400 800 950
21	700 800 800	700 800 900	700 800 800	500 700 600	600 700 700	700 800 800	700 800 800	500 700 800	600 700 700
22	500 500 800	600 700 750	700 850 900	800 850 950	700 800 900	800 900 900	500 650 700	400 500 750	900 900 900
23	310 400 500	370 470 600	250 380 500	600 730 850	430 570 700	750 775 850	600 700 800	450 650 700	600 650 750
24									
25	750 750 750	750 600 600	900 900 900	700 700 700	600 600 600	400 800 800	900 900 900	200 500 500	800 800 800
26	700 800 850	400 800 800	500 700 750	700 800 900	500 700 700	500 600 600	850 850 850	800 850 900	900 900 900
27	700 800 850	600 800 850	800 850 900	700 800 850	600 800 850	800 850 900	900 950 1000	750 800 850	900 900 950
28	600 800 900	500 500 500	500 700 700	900 400 900	800 800 800	900 900 900	800 800 800	100 200 200	800 800 800
29	700 700 900	570 600 630	570 620 650	850 870 870	600 600 600	675 675 725	770 770 700	550 750 650	750 800 750
30	570 670 730	850 850 880	530 620 620	500 500 500	400 400 500	100 100 125	500 500 500	100 300 400	700 700 700
31	600 650 680	480 600 650	570 700 730	670 850 850	730 830 770	650 700 700	600 650 600	300 500 550	700 800 800

MEAN INDICES
OF COMPETENCE

42 381 50 SHEETS 5 SQUARE
42 382 100 SHEETS 5 SQUARE
42 389 200 SHEETS 5 SQUARE

42 381 50 SHEETS 5 SQUARE
42 382 100 SHEETS 5 SQUARE
42 389 200 SHEETS 5 SQUARE





ATTACHMENT F

	Politicians	Congress	Media	Budgetary Analysis	Business	Mil/Civ.	Personnel	Labor	Ethics
1)	1000	1000	950	1000	930	1000	1000	800	1000
2)	1000	900	900	1000	900	925	900	750	1000
3)	900	900	900	900	900	900	900	700	950
4)	850	820	850	900	900	900	900	700	900
5)	800	810	800	830	830	900	900	700	900
6)	800	800	800	800	800	850 \pm UH	850 \pm UH	600 \pm UH	900
7)	750	750	800	800	750	800	800	550	900
8)	725 \pm UH	750 \pm UH	800	800 \pm UH	750 \pm UH	800	800	550	900 \pm UH
9)	700	700	800 \pm UH	700	700	800	800	500	850
10)	700	700	750	700	700	800	800	500	800
11)	700	700	725	700	600	800	800	500	800
12)	700	700	700	690	600	750	800	450	800
13)	650	700	700	670	600	700	770	400	800
14)	600	700	650	670	600	700	750	400	800
15)	600 \leftarrow M	700 \leftarrow M	600 \leftarrow M	650 \leftarrow M	600 \leftarrow M	700 \leftarrow M	750 \leftarrow M	400 \leftarrow M	800 \leftarrow M
16)	600	600	600	600	600	700	700	350	800
17)	570	600	600	600	600	700	700	300	750
18)	550	600	600	580	600	700	700	300	750
19)	530	600	530	500	500	700	670	250	700
20)	500	570	500	500	500	675	650	200	700
21)	500	500	500	500	500	650	615	200 \downarrow LH	650
22)	500 \downarrow LH	500 \downarrow LH	480 \downarrow LH	500	500 \downarrow LH	575 \downarrow LH	600	100 \downarrow LH	650 \downarrow LH
23)	450	480	400	500	430	550	600 \downarrow LH	100	600
24)	470	400	370	500 \downarrow LH	430	500	530	100	600
25)	400	380	310	370	430	500	500	100	600
26)	400	360	200	300	400	500	500	100	600
27)	400	310	200	300	400	400	500	100	600
28)	250	200	100	300	200	200	400	100	600
29)	200	100	100	200	200	100	200	100	400

Key : M \Rightarrow median

UH \Rightarrow upper hinge

LH \Rightarrow lower hinge